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Picarello et al.

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(54) **STRADDLE TYPE CONTAINER LIFTING DEVICE**

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(58) **Field of Search** ..... 414/392, 458, 414/459, 460, 561, 803; 294/670 DA, 81.1, 81.53

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(57) **ABSTRACT**

A lifting apparatus including a horizontal framework, a pair of extension assemblies, a pair of upper, middle, and lower telescoping mast assemblies, and two pairs of fork tine assemblies is provided. Each pair of the extension assemblies, the telescoping mast assemblies, and the fork tine assemblies is identical to the other one in structure and function. The horizontal framework is coupled to an overhead bridge crane and is accessible to any load located within a minimum amount of aisle space.

15 Claims, 5 Drawing Sheets

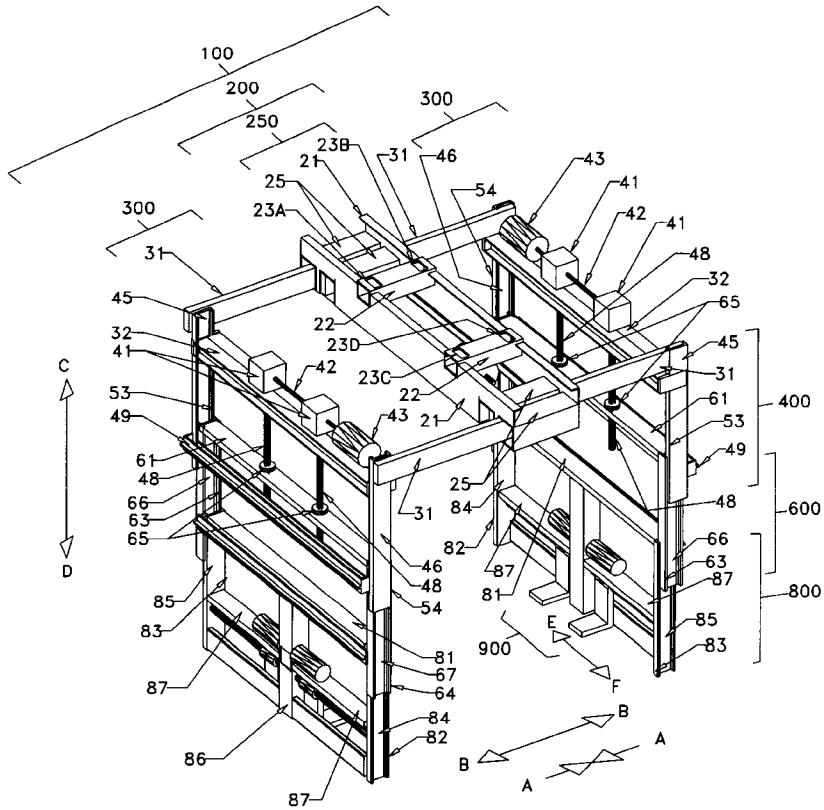
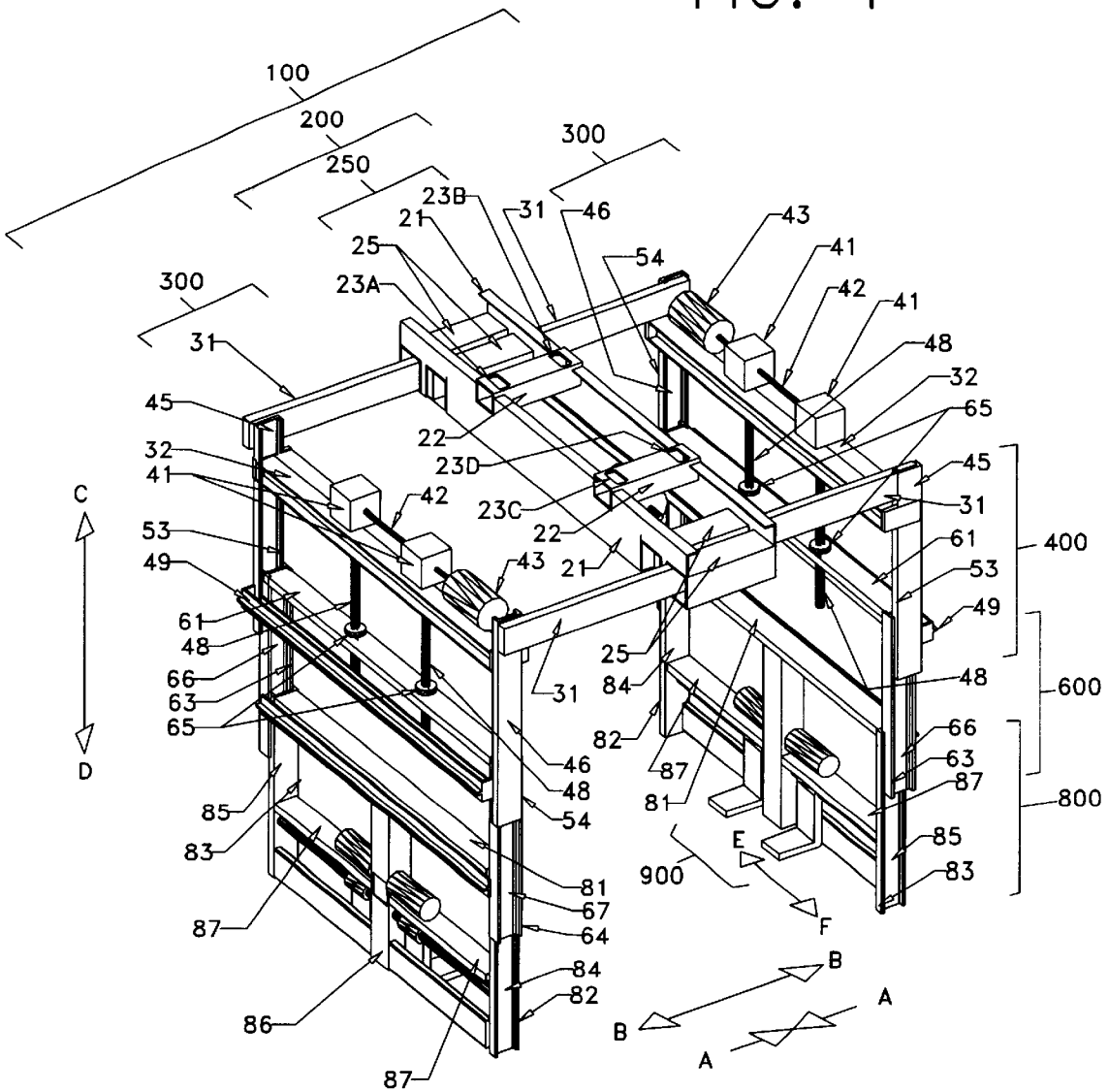


FIG. 1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23D
23C
22
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83
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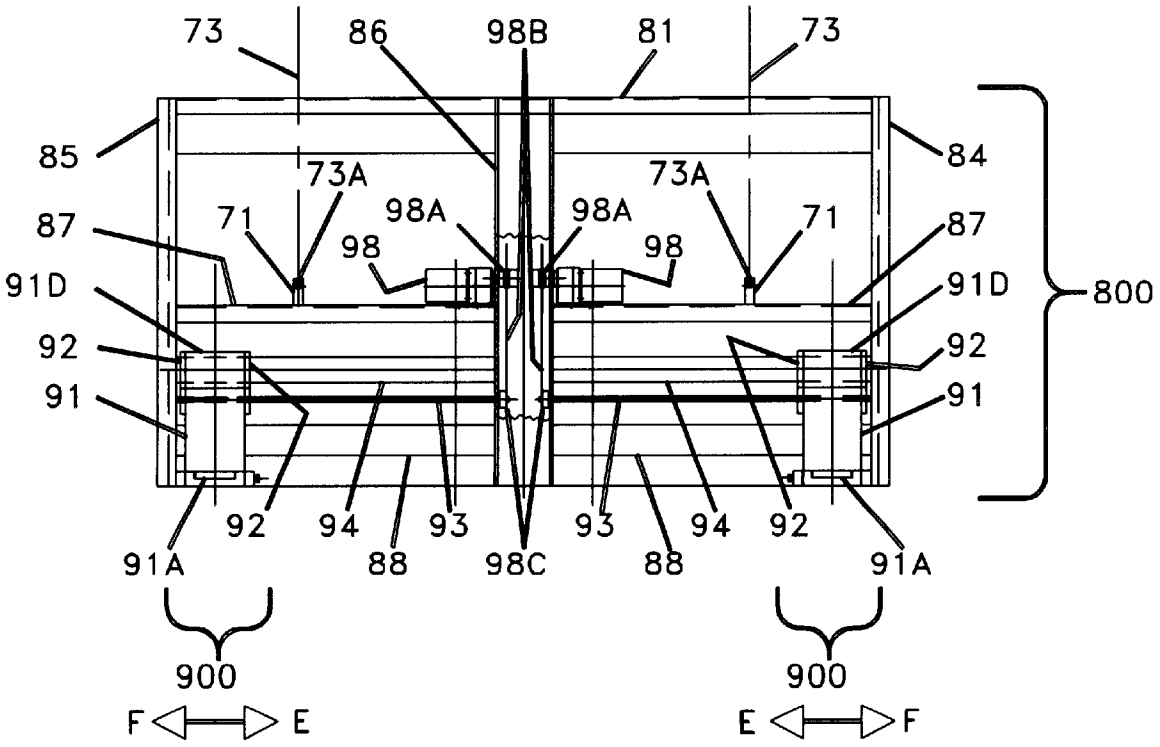
FIG. 2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91
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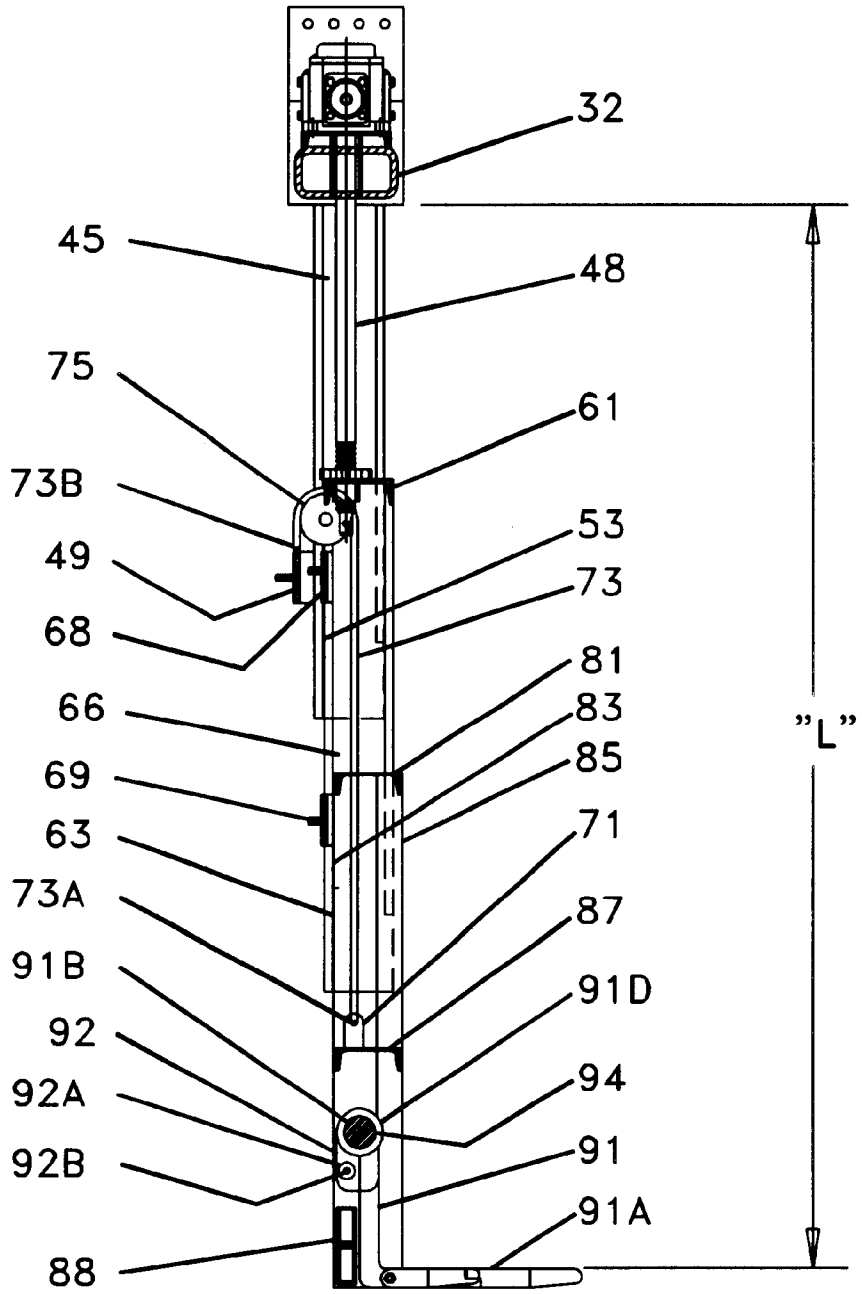
Fig. 3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"L"
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73A
87
91B
91D
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94
92A
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92B
91A
88

FIG. 5

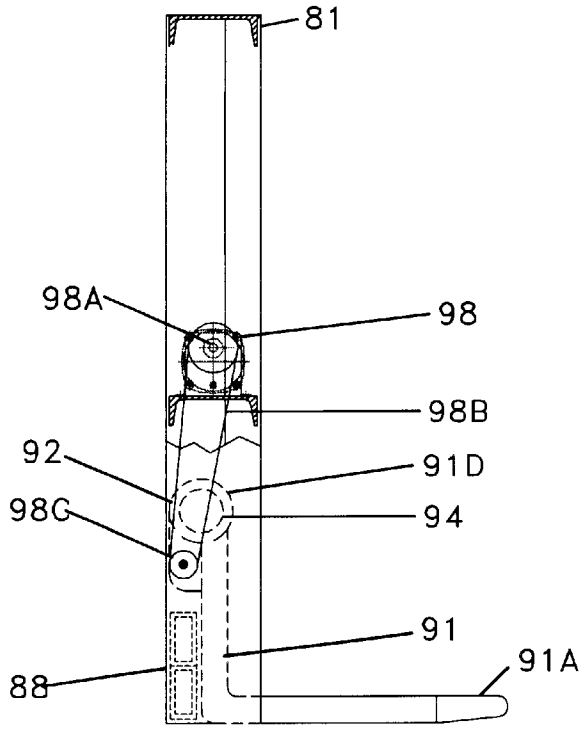
81
98A
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FIG. 4

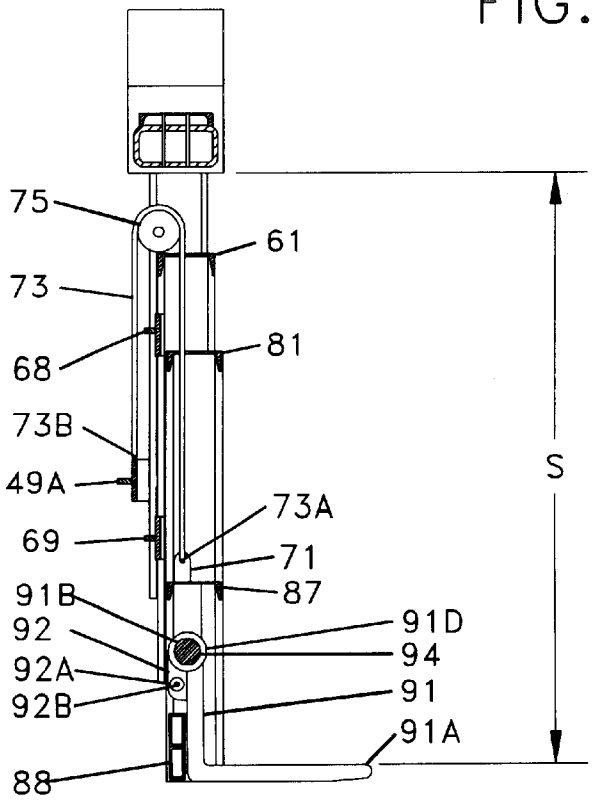
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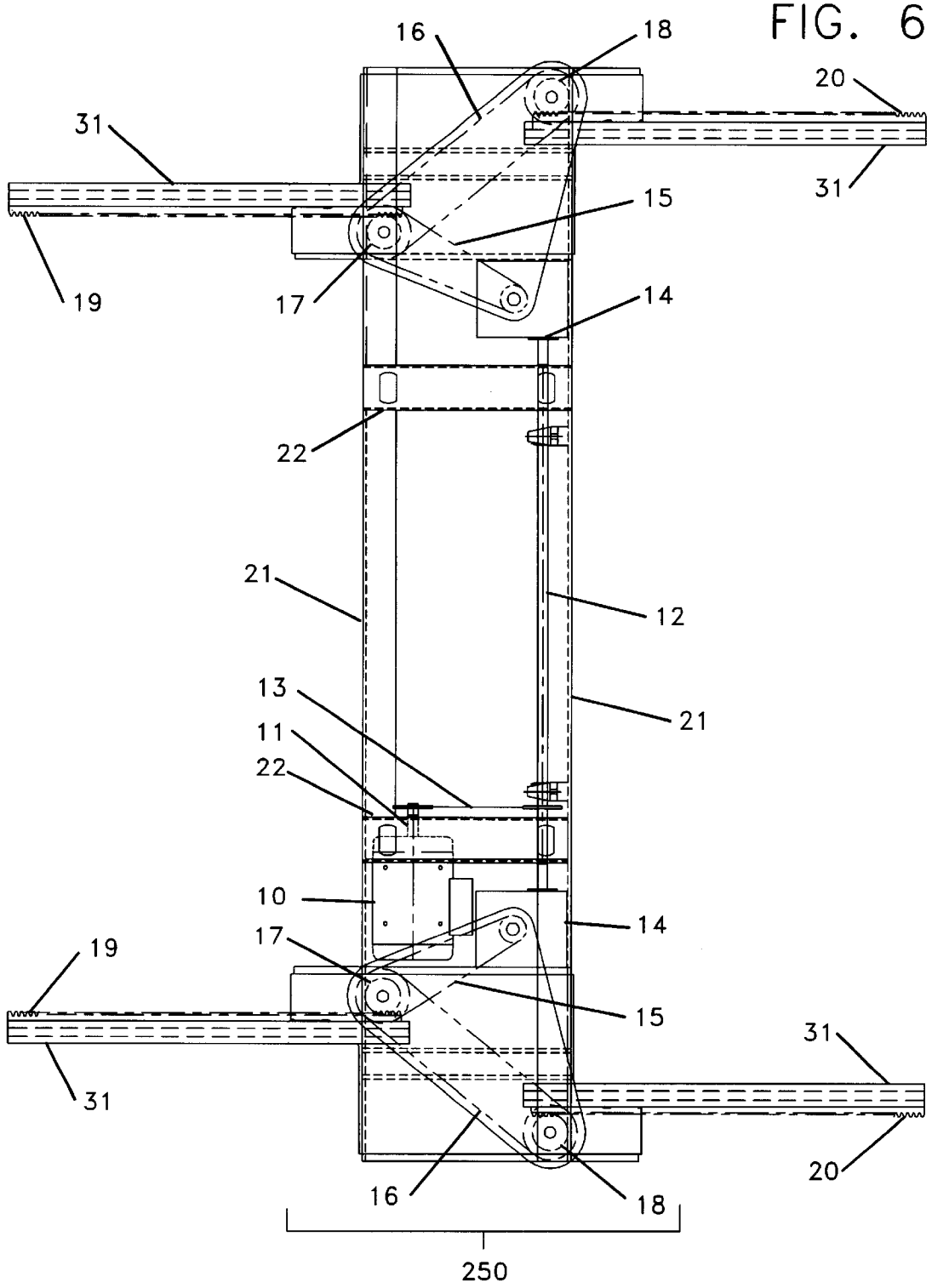
FIG. 6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STRADDLE TYPE CONTAINER LIFTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lifting apparatus, and more particularly to a lifting apparatus of adjusting spaced-apart tines to fit a load depending on the fork pocket spacing, height, and width of the load.

2. Brief Description of the Prior Art

Fork tines have been used for lifting and moving a load. Typically, fork tines mounted on a frame of a lifting apparatus are spaced-apart from each other. Because a height of the frame and a distance between fork tines are fixed, the lifting apparatus is limited to use for lifting and carrying a fixed-sized load. A plurality of lifting apparatuses and a bulky and complicated lifting apparatus have been used for the various sized loads. Moreover, depending on various sizes of a width, a height, and a length of the loads, the lifting apparatus having only one dimensional adjustment is not enough to lift and move the various sized loads.

In efforts of adjusting a distance between fork tines or a height of the frame in the lifting apparatus, U.S. Pat. No. 5,984,050 for a Carriage Suspension For Lift Truck issued to Ronald, U.S. Pat. No. 5,829,948 for a Multipurpose Lift Apparatus and Method issued to Becklund, U.S. Pat. No. 5,758,747 for a Mast Support for Forklift issued to Okazaki et al., U.S. Pat. No. 5,722,511 for a Lifting Vehicle and Method of Operating the Vehicle issued to Wakamiya, U.S. Pat. No. 5,586,619 for a lifting Apparatus issued to Young, U.S. Pat. No. 5,509,774 for a Load Clamping apparatus with an Increased Extent of Vertical Movement issued to Yoo, U.S. Pat. No. 5,379,863 for a Crane issued to Sugawara et al., U.S. Pat. No. 5,409,346 for a Self-Loading and Unloading Forklift Truck issued to Grether, U.S. Pat. No. 4,358,239 for a Warehouse Crane Including Inclinable Tote Pan Puller issued to Dechantsreiter, and U.S. Pat. No. 3,993,202 for a Storage System With Adjustable Interconnected Crane Towers issued to Neitzel disclose various types of lifting apparatuses having the fork tines. These references, however, show mechanisms adjusting only one dimension of the fork tines depending on the size of the load or complicated mechanisms adjusting one or two dimensions of the fork tines and including a tractor or a truck.

Regarding screw jack mechanisms, U.S. Pat. No. 5,118,082 for a Electrical Operated Screw-Type Jack issued to Byun, U.S. Pat. No. 4,641,813 for a Dual Automobile Jack For Consumer Use issued to Arzouman, and U.S. Pat. No. 4,609,179 for a Screw Jack issued to Chem et al. disclose typical structures of screw jacks. These references, however, do not show any application for a lifting apparatus.

Therefore, we have noticed that the conventional method and apparatus fail to show a lifting apparatus having a variable range of the width, height, and length of the frame and the fork tines depending on various sizes of width, height, and fork pocket spacing of the loads and that the lifting apparatus as shown in these references are not enough to lift and move various sized loads in width, height, and length. Moreover, when the various sized loads should be located in a limited space or a designated storage location, the conventional lifting apparatus can not move within the space and carry the various sized loads into the limited space.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a lifting apparatus suitable to lift and carry all various sized loads.

It is another object of the present invention to provide a lifting apparatus able to load a container into a limited space and a designated storage location.

It is yet another object to provide a lifting apparatus able to adjust to any width, height, and fork pocket spacing.

It is still another object to provide a lifting apparatus able to adjust a frame to fit a load.

It is a further object to provide a lifting apparatus able to access a load within a minimum amount of aisle space.

It is also another object to provide a lift apparatus able to adjust all of the width, the height, and fork pocket spacing of the frame or fork tines simultaneously.

These and other objects may be achieved by providing a lifting apparatus including a horizontal framework, two pairs of extension assemblies, a pair of upper, middle, and lower telescoping mast assemblies, and two pair of fork tine assemblies. Each one of the pairs of the extension assemblies, the telescoping mast assemblies, and the fork tine assemblies is identical to the other one in structure and function. The horizontal framework is coupled to an overhead bridge crane and is accessible to any load located within a minimum amount of aisle space.

The horizontal framework includes a pair of horizontal supporters spaced-apart from each other and a pair of horizontal connectors secured to both ends of the horizontal supporters. Two brackets fixed between the spaced-apart horizontal supporters connected to the bridge crane trolley by securing to hooks or twist lock connectors of the bridge crane trolley to brackets.

A horizontal motor mounted on one of the horizontal supporters is connected to a frame shaft through a first shaft extended from the horizontal motor, to a pulley and belt assembly. The frame shaft is coupled to a pair of gear reduction units mounted on the horizontal supporter. The output end of each gear reduction unit is coupled to a pulley and belt assembly. Each pair of pulley and belt assemblies directs torque to a pair of inboard pinion gears and outboard pinion gears, both of which operate in synchronized motion through a final pulley and belt drive.

All of the extension assemblies, the upper, middle, and lower telescoping masts, and fork tine assemblies move toward or from the horizontal framework. Therefore, a distance between pairs of extension assemblies, the upper, middle, and lower telescoping masts, and fork tine assemblies is adjusted by the rotation of the horizontal motor and the frame shaft pulleys, belts and pinion gears.

The upper mast assembly is mounted beneath the extension supporter and includes two upper vertical beams spaced-apart from each other and two upper horizontal side bars attached to the spaced-apart upper vertical beams to maintain a distance between the spaced-apart upper vertical beams. Pairs of rails are formed on the upper vertical beams. A vertical motor mounted on the extension supporter is coupled to vertical screws within the power screw jack through a second shaft extended from the vertical motor. The vertical screws are rotatably mounted on the upper vertical assembly. Ends of the vertical screws are coupled to the second shaft within the power screw jacks while the other ends of the vertical screw are inserted into holes formed on the middle horizontal beam through fixed nuts attached to the middle horizontal beam. A thread portion formed inside of the fixed nut is coupled to a peripheral outside of the vertical screw.

A middle mast assembly coupled to the vertical screw of the upper mast assembly through the fixed nut includes two

middle vertical beams spaced-apart from each other and two middle horizontal beams attached to spaced-apart middle vertical beams to maintain a distance between spaced-apart middle vertical beams. Two pairs of rails formed on the two middle vertical beams have a telescoping relationship with each pair of rails of upper vertical beams.

A lower mast assembly includes two lower vertical beams spaced-apart from each other and lower horizontal beams, each end coupled to spaced-apart lower. vertical beams. A lifting chain is coupled to both the upper and lower mast assemblies through a pulley rotatably mounted on the middle horizontal beam of the middle mast assembly. An anchor is secured to the lower horizontal beam. The lifting chain has one end connected to the anchor and the other end connected to the lower horizontal side bar of the upper mast assembly while a portion of the lifting chain is wound around a peripheral surface of the pulley. A fork tine assembly is mounted on the lower mast assembly, and two fork tines are spaced-apart from each other by a pair of tine motors and power screw drive-shafts mounted on the lower mast assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

FIG. **1** is a perspective view showing a lifting device according to the principle of the present invention;

FIG. **2** is a partial cross-sectional view illustrating a lower mast assembly of the lifting device;

FIG. **3** is a partial cross-sectional view illustrating a maximum height of a vertical lifting assembly of the lifting device;

FIG. **4** is a partial cross-sectional view illustrating a minimum height of a vertical lifting assembly of the lifting device;

FIG. **5** is a partial cross-sectional view illustrating a fork tine assembly of the lifting device; and

FIG. **6** is a view illustrating the horizontal drive mechanism of the lifting device.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter an embodiment according to the principle of the present invention will be described in detail with reference to accompanying drawings.

Referring now to FIG. **1**, a container lifting device **100** includes a horizontal framework **200**, a horizontal drive mechanism **250**, a pair of extension assemblies **300**, each with a pair of upper, middle, and lower telescoping mast assemblies **400**, **600**, **800**, and a pair of fork tine assemblies **900**. Each one of the pair of extension assemblies **300**, telescoping mast assemblies **400**, **600**, **800**, and fork tine assemblies **900** is identical to the other one in structure and function.

The horizontal framework **200** defines a pair of horizontal supporters **21** spaced-apart from each other and a pair of horizontal connectors **25** secured to both ends of the horizontal supporters **21**. Two brackets **22** are fixed between spaced-apart horizontal supporters **21** and include connecting holes **23**A thru D connected to twist lock connectors of a bridge crane trolley not shown. Lifting device **100** is connected to the bridge crane trolley by securing the connector fittings of the bridge crane trolley to connecting holes **23**A thru D in lifting device **100**.

The horizontal drive mechanism **250** is more fully depicted in FIG. **6**. A horizontal motor **10** is mounted on one of horizontal supporters **21**. A first shaft **11** extended from horizontal motor **10** is connected to a frame shaft **12** through a pulley and belt assembly **13**. The frame shaft **12** is coupled to a pair of speed reduction gear units **14** on opposite ends of the frame shaft **12**. The speed reduction gear units are connected to a pair of pulley and belt assemblies **15**. Pulley and belt assemblies **15** direct power to inboard pinion gears **17** and outboard pinion gears **18** in synchronized motion through the use of pulley and belt drive assemblies **16**. Each of the pinion gears **17** and **18** moves a matching gear rack **19** and **20** rigidly attached to horizontal carriages **31**. One end of the horizontal carriages **31** are fixed to extension supporters **32** while the other end of horizontal carriages **31** are inserted into horizontal connectors **25**. Both pairs of horizontal carriages **31** move smoothly, and the same distance, within horizontal connectors **25** during the movement resulting from matching gear racks **19** and **20**. Therefore, referring again to FIG. **1**, extension assemblies **300** remain horizontally spaced-apart by an equal, predetermined distance from horizontal drive mechanism **250** based upon the system described above.

If a wide container is lifted, each one of extension assemblies **300**, upper, middle, and lower telescoping masts **400**, **600**, **800**, and fork tine assemblies **900** moves in the direction of arrow "B" thereby widening the distance between each pair to fit the width of the wide container. If the lifting device **100** lifts a narrow container, each one of extension assemblies **300**, upper, middle, and lower telescoping masts **400**, **600**, **800**, and fork tine assemblies **900** moves in the direction of arrow "A" thereby narrowing the distance between each pair to fit the width of the narrow container. Depending on the width of a container, the width of lifting device **100** is adjusted to fit the width of the container.

Since each one of the pair of extension assemblies **300**, upper, middle, and lower telescoping masts **400**, **600**, **800**, and fork tine assemblies **900** is identical to the other pair in structure and function, only one of each pair is explained and described hereinafter.

Upper mast assembly **400** is mounted beneath of extension supporter **32** and defines two upper vertical beams **45** and **46** spaced-apart from each other and having upper ends attached to beneath of extension supporter **32**. One upper horizontal side bar **49** is attached to spaced-apart upper vertical beams **45** and **46** to maintain a common distance. Pairs of rails **53**, **54** are formed on upper vertical beams **45** and **46**.

A vertical motor **43** is mounted on extension supporter **32**. Second shaft **42** extended from vertical motor **43** is inserted into second power screw jacks **41** and coupled to vertical screws **48** rotatably mounted on middle telescoping mast assembly **600**. Vertical screws **48** rotate by the rotation of second shaft **42** and vertical motor **43**. One end of vertical screws **48** are coupled to second shaft **42** through second power screw jacks **41** while the other end of vertical screws **48** are inserted into holes formed on the middle horizontal beam **61** through fixed nuts **65** fixed on middle horizontal beam **61**. A thread portion formed inside of fixed nut **65** is coupled to a teeth portion formed on the peripheral outside of vertical screw **48**.

Middle mast assembly **600** is coupled to vertical screw **48** of upper mast assembly **400** through fixed nut **65** and defines two middle vertical beams **66** and **67** spaced-apart from each other and three middle horizontal beams **61**, **68**, and **69** attached to vertical beams **66** and **67** to maintain a common distance between them. Two pairs of rails **63** and **64** formed on the two middle vertical beams **66** and **67** have a telescoping relationship with each pair of rails **53** and **54** of upper vertical beams **45** and **46**. Rotation of vertical screws **48** causes fixed nuts **65** coupled to thread portion of vertical screws **48** to move up and down along vertical screws **48** in a direction of an arrow "C" or "D" depending on a rotating direction of vertical screw **48**. Since fixed nut **65** is fixed to middle horizontal beam **61** and moves along vertical screw **48** in the direction of arrow "C" or "D" middle vertical beams **66** and **67** slidably move along inside of upper vertical beams **45** and **46**. Thus, middle mast assembly **600** moves up toward and down from extension supporter **32**.

As shown in FIGS. **1** through **3**, lower mast assembly **800** defines two lower vertical beams **84** and **85** spaced-apart from each other by lower horizontal beams **81** and **87**. A lifting chain **73** is coupled to both upper and lower mast assemblies **400** and **800** through a pulley **75** rotatably mounted on middle horizontal beam **61** of middle mast assembly **600**. An anchor **71** is secured to lower horizontal beam **87**. Lifting chain **73** has one end **73**A connected to anchor **71** and the other end **73**B connected to upper horizontal side bar **49** of upper mast assembly **400** while a portion of lifting chain **73** is wound around the peripheral surface of pulley **75**.

When middle mast assembly **600** moves up along vertical screw **48** toward extension supporter **32** in the direction of arrow "C" pulley **75** moves away from upper horizontal side bar **49** and moves toward extension supporter **32**. Since lifting chain **73** is wound around pulley **75** mounted on middle horizontal beam **61** of middle mast assembly **600**, and each end **73**A and **73**B of lifting chain **73** is coupled to lower horizontal beam **87** of lower mast assembly **800** and upper horizontal side bar **49** of upper mast assembly **400** respectively, lower mast assembly **800** moves toward middle and upper. mast assemblies **600** and **400** and extension supporter **32** if middle mast assembly **600** moves up toward upper mast assembly **400** and extension supporter **32**. In this position,. pulley **75** is located approximately half-way along lift chain **73**. On the contrary, if middle mast assembly **600** moves. down from upper mast assembly **400** and extension supporter **32** in the direction of arrow "D", lower mast assembly **800** moves away from middle and upper mast assemblies **600** and **400** and extension supporter **32**. In this position, pulley **75** is located adjacent to a portion of the other end **73**B of lifting chain **73**.

Therefore, a height of the telescoping mast assembly including upper, middle, and lower mast assemblies **400**, **600**, **800** can be adjusted depending on the height of a container or a load. A maximum height "L" of the telescoping mast assembly is shown in FIG. **3** while a minimum height "S" of the telescoping mast assembly which telescopes is shown in FIG. **4**. Rail **83** of lower vertical beam **85** slides into inside of rail **63** of middle vertical beam **66** which slides into inside of rail **53** of upper vertical beam **45** while rail **82** of lower vertical beam **84** slides over the outside surface of rail **64** of middle vertical beam **67** which slides over the outside surface of rail **54** of upper vertical beam **46** during adjusting the height of the telescoping mast assembly.

The width of lifting apparatus **100** is adjusted by horizontal motor **10**, horizontal framework **200**, and extension assembly **300** while the height of lifting apparatus **100** is adjusted by vertical motor **43** and the telescoping mast assembly including upper, middle, and lower mast assemblies **400**, **600**, **800**. Instead of horizontal motor **10**, frame shaft **12**, a pair of hydraulic or pneumatic cylinders can be mounted on horizontal supporter **21** of horizontal frame work **200** or extension supporter **32** of extension assembly **300**. If the cylinders are mounted on horizontal supporter **21** of horizontal frame work **200**, a shaft extended from the cylinder is connected to each extension supporter **32** of extension assembly **300**. If the cylinders are mounted on extension supporter **32** of extension assembly **300**, the shaft extended from the cylinder is connected to each horizontal supporter **21** of horizontal frame work **200**.

Referring now to FIGS. **2**, **4**, and **5**, a fork tine assembly **900** is mounted on lower mast assembly **800**. A pair of tine motor **98** are mounted on lower horizontal supporter **87** of lower mast assembly **800**. Longitudinal fork screw **93** is rotatably mounted on spaced-apart lower vertical beam **85** and internal vertical beam **86** and is connected to tine motor **98** through a shaft **98**A, a pulley and belt **98**B, and a pulley **98**C. A traveling frame **92** having a thread hole **92**A and two spaced-apart guide. protrusions **92**B is coupled to a thread portion of fork screw **93** and moves in a direction of an arrow "E" or "F" by rotation of fork screw **93**. Two ends of tine axle **94** are fixed to spaced-apart lower vertical beam **85** and internal vertical beam **86** respectively after tine axle **94** is inserted into tine hole **91**B formed on head portion **91**D of fork tine **91**. Head portion **91**D of fork tine **91** is located between two spaced-apart guide protrusions **92**B of traveling frame **92**. Fork tine **91** slides along tine axle **94** by movement of traveling frame **92** and moves in the same direction of guide protrusions **92**B of traveling frame **92**. Tine body supporter **88** is disposed to support fork tine **91** during loading a container or a load on tine extensions **91**A of fork tine **91** thereby preventing fork tine **91** from rotating about an axis of tine axle **94**.

Depending on the fork pocket locations of the container, the distance between fork tines **91** can be adjusted by fork tine assembly **900** to fit the container fork pocket spacing when fork tines **91** move in the direction of arrow "E" or "F". Therefore, the width, height, and fork tine spacing of lifting apparatus **100** are adjusted by horizontal motor **10**, horizontal framework **200**, and extension assembly **300**, vertical motor **43** and the telescoping mast assemblies **400**, **600**, and **800**, and fork tine assembly **900** respectively depending on the width and height of the container and spacing of its fork pockets.

As described in the above, there are advantages in the lifting apparatus for adjusting the width, height, and fork tine spacing of the lifting apparatus according to the principle of the present invention in that the lifting device includes a great amount of adjustability to handle various unit load heights and tine positions that allow the lifting device to load containers having different dimensions into a fixed, narrow space.

What is claimed is:

1. A lifting device, comprising:

a horizontal framework having a pair of horizontal supporters connected to a pair of horizontal connectors;

at least a pair of horizontal carriages slidably inserted into said horizontal connectors approximately perpendicular to said horizontal supporters;

a horizontal drive mechanism, comprising a pulley and belt system, wherein said horizontal drive mechanism may move said horizontal carriages within said horizontal connectors, wherein the pulley and belt system comprises:

a first shaft connected to said horizontal motor;

a frame shaft having first and second ends connected to said first shaft;

a pair of speed reduction gear units wherein said speed reduction gear units connect to said first and second ends of said frame shaft;

a pair of pulley and belt drive assemblies connected to said pair of speed reduction gear units;

a pair of inboard pinion gears and a pair of outboard pinion gears driven in synchronized motion through said pulley and belt drive assemblies; and,

a pair of gear racks moved by said pair of inboard and said pair of outboard pinion gears wherein said gear racks move said extension supporters horizontally;

at least a pair of extension units disposed on opposite sides of said horizontal supporters and connected to said horizontal carriages wherein said extension units remain approximately parallel when said horizontal drive mechanism moves said horizontal carriages toward or away from said horizontal framework;

at least a telescoping mast unit having a plurality of telescoping mast assemblies, connected to said extension unit and approximately perpendicular to said horizontal framework, vertically moving toward and away from said extension unit; and

at least a fork tine assembly mounted on one of said telescoping mast assemblies, having at least a pair of tines spaced-apart from each other.

2. The lifting device of claim **1**, further comprising a bracket that allows said horizontal framework to connect to a bridge crane.

3. The lifting device of claim **2**, wherein said horizontal drive mechanism further comprises a horizontal motor to drive the pulley and belt system.

4. The lifting device of claim **3**, further comprising:

a vertical motor connected to said telescoping mast assembly wherein said vertical motor vertically moves said telescoping mast assembly toward and away from said extension unit.

5. The lifting device of claim **4**, wherein said telescoping mast assembly comprises:

an upper mast assembly connected to said extension unit and approximately perpendicular to said horizontal framework;

a middle mast assembly, having a rotatable pulley, telescoped into said upper mast assembly and connected to said upper assembly through at least a vertical screw connected to said vertical motor wherein said vertical motor rotates said vertical screw to vertically move said middle mast assembly; and

a lower mast assembly, having a lifting chain with a first and second end, said chain connected to said upper mast assembly and said lower mast assembly wherein vertical movement of said middle mast assembly results in vertical movement of said lower mast assembly.

6. The lifting device of claim **5**, wherein said telescoping mast assembly further comprises:

a pulley rotatably mounted on said middle mast assembly, said lifting chain wound around said pulley;

said first end of said lifting chain connected to lower mast assembly; and

said second end of said lifting chain connected to said upper mast assembly.

7. The lifting device of claim **6**, wherein said telescoping mast unit further comprises a power screw jack coupling said vertical motor to said vertical screw.

8. The lifting device of claim **7**, wherein said telescoping mast assembly further comprises a fixed nut mounted on said middle mast assembly, coupled to said vertical screw, movable along said vertical screw when said vertical motor rotates said vertical screw.

9. The lifting device of claim **8**, wherein said fork tine assembly comprises at least a tine motor connected to said tines wherein said tine motor moves said tines toward and away from each other.

10. The lifting device of claim **9**, wherein said fork tine assembly further comprises:

a fork screw having a thread portion, connected to said tine motor, rotatably mounted on said lower mast assembly;

a traveling frame coupled to said thread portion of said fork screw wherein said traveling frame moves approximately planer to said lower mast assembly when said fork screw rotates; and,

a guide protrusion extended from said traveling frame, moving said tines.

11. The lifting device of claim **10**, wherein said fork tine assembly further comprises:

at least a tine hole formed on said tines; and,

at least a tine axle inserted into said tine hole, connected to said lower mast assembly, wherein said tines slide along said tine axle through the movement of said traveling frame.

12. The lifting device of claim **11**, wherein said fork tine assembly further comprises a tine body supporter mounted on said lower mast assembly, disposed to support said tine and prevent said tine from rotating about said tine axle.

13. The lifting device of claim **12**, further comprising two pairs of horizontal carriages, each of said pairs of horizontal carriages inserted into said horizontal connectors.

14. The lifting device of claim **13**, further comprising:

two extension units; and,

two telescoping mast assemblies connected to said extension units.

15. The lifting device of claim **14**, further comprising two fork tine assemblies, each fork tine assembly mounted on the lower mast assembly of said telescoping mast assemblies wherein said fork tine assemblies face each other.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

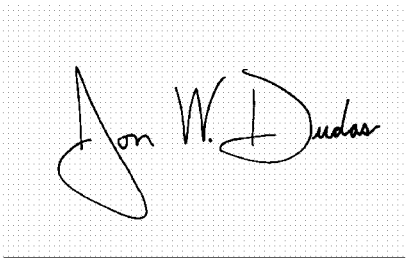
PATENT NO. : 6,364,601 B1
DATED : April 2, 2002
INVENTOR(S) : Picarello et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [*] Notice, delete the phrase "by 0 days" and insert -- by 41 days --

Signed and Sealed this

Twenty-eighth Day of September, 2004



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Director of the United States Patent and Trademark Office